

Using 3D product visualisation to tap consumers' experience with online retailers: From telepresence to authenticity

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Using 3D Product Visualisation To Tap Consumers' Experience With Online Retailers: From Telepresence To Authenticity.

Abstract:

This study investigates the effects of authentic three dimensional (3D) product visualisation versus 3D telepresence on consumers' virtual experience. A hypothetical retailer Web site presents a variety of laptops using 3D product visualisations for the within-subjects laboratory experiment. The first stage uses two-way repeated measures ANOVA to determine the effects of the progressive levels of control and animated colours on 3D authenticity (the dependent variable). In a second stage, we use structural equation modelling to test the proposed hypothesis. This research uses a U.K. sample to investigate the effects of 3D authenticity and 3D telepresence on willingness to purchase and reveals significant differences between telepresence and authenticity constructs. Authenticity is more significant in simulating an online retailer's products, and control and animated colours represent the main antecedents of authenticity. The proposed conceptual model achieves acceptable fit and the hypothesised paths are all valid.

-Key words: control; animation; telepresence; authenticity; virtual experience

Scholars (e.g., Li et al., 2001, 2002, 2003) classify experiences, based on the interaction between a product or an environment and an individual, into three types. First, direct experience permits consumers to interact (e.g., physically) directly with a product. Second, indirect experience often allows consumers to interact with second-hand source such as static visual pictures. Third, virtual experience allows consumers to interact with three dimensional (3D) virtual models. According to Steuer (1992, p.78) virtual reality (VR) is "*a real or simulated environment in which a perceiver experiences telepresence*". In contrast, virtual experience (VE) derives from VR and can be defined as "*psychological and emotional states that consumers undergo while interacting with a 3D environment*" (Li et al. 2001, p. 14). A 3D presentation enables consumers to interact with products, enriches their learning processes, and creates a sense of being in a simulated real world. Furthermore, direct and virtual experiences combine within VR, such that the latter enhances and enriches the overall experience because consumers use almost all of their senses when interacting with a 3D

product visualisation (Klein, 2003; Li et al., 2001, 2002, 2003). Despite widespread discussions and various definitions of VE, we notice that previous scholars, within the online retail context, consider the notions of 3D telepresence as virtual substitutes for actual experience with the products. However, the telepresence and presence constructs are not necessarily wholly appropriate concepts for marketers since they represent a process of being mentally transported into other areas or being immersed into an illusion environment. Such notions may not be particularly helpful for marketers and website designers who are concerned with 3D product visualisation of real products. Instead, we propose the authenticity construct, which refers to simulating a real product authentically online. We therefore first discuss the notions of telepresence or presence and their antecedents in the immersive virtual reality (IVR) environment then proceed to explain applications of non-immersive virtual realities (NIVR i.e., an online retailer context). We also offer a new definition and measurement scale for the construct of authenticity. Furthermore, to understand the influences of 3D authenticity antecedents, we manipulated the control and animated colours constructs and measured their impact on the perceived 3D authenticity construct (the dependent construct). Finally, using the high levels of 3D authenticity antecedents, 3D authenticity, telepresence and willingness to purchase, we developed a conceptual framework and tested the relationships in the proposed model.

THEORETICAL BACKGROUND

3D Telepresence in the Immersive and Non-Immersive VR

VR terminologies enter the vocabulary with the emergence of IVR devices, such as head-mounted display, which allow users to interact with virtual environments and to visualise different objects (Suh and Lee, 2005). As a result, the notions of telepresence or presence emerge. Notwithstanding, previous literature in the IVR area has provided readers with different classifications and conceptualisations of VR. For example, Steuer's (1992, p. 76) definition of VR focuses on human experience, not technological hardware, and differentiates between presence and telepresence. Whereas presence refers to “*the experience of one’s physical environment; it refers not to one’s surroundings as they exist in the physical world, but to the perception of those surroundings as mediated by both automatic and controlled mental processes*”, telepresence is “*the experience of presence in an environment by means of*

a communication medium". In turn, Sheridan (1992) distinguishes between virtual presence and telepresence, such that presence relates to the sense of being in a computer-mediated environment, whereas telepresence indicates a sense of being in any real remote location. To that end, Biocca and Delaney (1995) argue that the definition of VR depends on technological hardware and software. The authors define VR as perceptual immersion presence. This type of presence depends on sensory immersion in virtual environments. To extend prior literature, Lombard and Ditton (1997) identify six taxonomies of VR presence: social richness, realism, transportation, immersion, social actor within medium and medium as social actor. Notwithstanding Lombard and Ditton's (1997) classification, two types of presence are identified in the NIVR area, concerning users interaction with e-retailers' websites and products using desktop or laptop computers (Suh and Lee, 2005). The first is telepresence, or the illusion of being in a place far from the physical body (Biocca, 1997; Heeter, 1992). This conceptualisation of telepresence relates to transporting a user, self, or place, to another place. The second form is telepresence in a social sense, such that other beings exist in the VR world with whom users can interact (e.g., avatars). Authors such as Heeter (1992) and Lombard and Ditton (1997) empirically test this concept, and McGoldrick and colleagues (2008) emphasise the avatar's role in enhancing virtual personal shopper capabilities.

3D Telepresence Antecedents in Immersive and Non-Immersive VR

Interactivity and vividness may represent the main determinants of telepresence within IVR (Biocca and Delany, 1995; Heeter, 1992; Lombard and Ditton, 1997; Sheridan, 1992; Steuer, 1992; Witmer and Singer, 1998). Interactivity appears particularly of interest since the appearance of communication channels such as the World Wide Web, for which it represents a critical concept and primary advantage (Morris and Ogan, 1996; Rafaeli and Sudweeks, 1997). Considerable research investigates and empirically tests the construct, but there is little agreement on the definition or operationalisation of the interactivity construct (e.g., Ariely, 2000; Klein, 2003; Liu and Shrum, 2002; McMillan and Hwang, 2002). For example, Steuer (1992) classifies it into three elements: speed, mapping and range. Rafaeli (1988) and Rafaeli and Sudweeks (1997) argue interactivity relates to the communication process, and Ariely (2000) defines it on the basis of the control construct (the narrowest definition). Wu (1999) relies on the self efficacy construct, whereas Rowley (2008) focuses on information

interactivity. Still other scholars (e.g., Downes and McMillan, 2000; Lui and Shrum, 2002; McMillan, 2002; McMillan and Hwang, 2002) argue that definitions of interactivity cannot be restricted to messages, human interactions or communications but rather should include multidimensional aspects. Thus speed, responsiveness and communications represent the main elements to define and measure interactivity antecedents. In contrast, vividness, according to Steuer (1992, p. 81) is “*the way in which an environment presents information to the senses*”. Steuer explains that vividness is stimulus driven and depends completely on the technical characteristics of a medium. In turn, it represents a product of two important variables: sensory breadth, and sensory depth. Most scholars use this definition of vividness.

Previous research on IVR (e.g., Biocca, 1997; Heeter, 1992; Lombard and Ditton, 1997; Sheridan, 1992) thus reveals several key findings. First, researchers from different fields (e.g., communication, business, psychology, and HCI) use different terms (e.g., presence, telepresence, virtual presence, immersion, mediated presence) to describe the same concept. However, some debate remains regarding definitions of presence and telepresence. Second, previous research uses presence and telepresence to explain VR experience, though these conceptualisations have depended on the level of technology (e.g., Biocca, 1992; Steuer, 1992; Sheridan, 1992). Whereas in the past researchers used display interface technologies such as goggles, head-mounted visors, data gloves, joysticks, head trackers and televisions to identify and measure presence (e.g., Biocca, 1992; Heeter, 1992; Lombard and Ditton, 1997; Sheridan 1992; Steuer, 1992; Witmer and Singer, 1998), more recent technological developments can “transport” users to other places, where they can see and interact with other intelligent beings (e.g., avatars in Second Life, chat rooms, online communities), without forcing them to wear technological devices. To address this issue, 3D online retail literature introduces the NIVR environment and explains the main antecedents of 3D telepresence. For example, in conceptualising consumer experiences in cyberspace, Shih (1998) posits that the vividness of the information (operationalised as multi-sensory information, i.e. breadth and depth) that a consumer receives in cyberspace and the interactivity of the cyberspace technology (operationalised as control, speed and feedback) provide the main antecedents of telepresence (i.e., being there). In turn, Coyle and Thorson (2001) investigate the effects of progressive levels of interactivity and vividness on Web marketing sites by manipulating levels of interactivity (number of choices and presence of a clickable image) and vividness (audio and animation). They find that high levels of interactivity and vividness increase participants’ feelings of “being there” (i.e., telepresence). Fortin and Dholakia’s (2005)

empirical research reveals the direct and indirect impacts of interactivity (degree of control, response time) and vividness (breadth and depth of the message, colours, graphics, quality and resolution) on social presence (i.e., being there). High levels of interactivity and vividness have significant impacts on perceived social presence. According to Klein (2003), Macromedia's Authorware© 3.0 and 4.0, represents simple technology and thus provides another means to examine the effects of telepresence (being transported into another area) on consumer responses. Moreover, Klein (2003) finds that interactivity (user control) and media richness (depth and breadth of sense channels) emerge as the main antecedents of telepresence, with significant positive influences on its creation.

Thus, previous studies in NIVR reveal that some authors consider interactivity and vividness as antecedents of telepresence (e.g., Fortin and Dholakia, 2005; Suh and Chang 2006; Suh and Lee, 2005), whereas others use vividness only (e.g., Hopkins et al., 2004). Still other authors consider interactivity and vividness the main indicators of telepresence (e.g., Kim et al., 2007; Song et al., 2007) but not its antecedents. Empirical tests of the influence of 3D on consumer experiences (e.g., Li et al., 2002; Suh and Lee, 2005; Hopkins et al., 2004 and Suh and Chang, 2006) indicate that 3D product simulations (the best user interface for enhancing telepresence) have direct and indirect impacts on product knowledge, product attitude, brand attitudes and purchase intentions. These studies imply that interactivity and vividness are the main antecedents of telepresence. On that basis, we claim that 3D telepresence and its abstract antecedents are not the suitable terminologies that marketers should use because they reflect a feeling of being transported, immersed and deluded into an inaccessible environment. Instead, we propose the notion of 3D authenticity and its antecedents (control and animated colours), reflecting the authentic representation of real products.

AUTHENTICITY CONSTRUCT

None of the previous definitions of telepresence or presence that use 3D virtual models realistically taps consumers' virtual experiences. A 3D virtual experience should be an authentic representation of the direct (offline) experience. We therefore propose a new notion that relates to the simulation of online products and virtual experience, namely, the authenticity of the product visualisation. Telepresence and presence are not particularly well suited to the online retail context, because they reflect illusion and transportation to other places. In contrast, the concept of 3D authenticity of the product visualisation implies the ability to simulate the product experience in bricks-and-clicks contexts. We propose the

following definition of perceived authenticity in a computer-mediated environment: Authenticity is a *psychological state in which virtual objects presented in 3D in a computer-mediated environment are perceived as actual objects in a sensory way*. To determine the influences of telepresence and authenticity on consumers experiences in an online retail context, we investigate the following research question:

How do consumers perceive 3D product virtualisation (telepresence) compared with 3D product authenticity on online retailers' Web sites?

Authenticity Antecedents and Definitions

We use the control construct to represent interactivity in an online retail context. Ariely's (2000) definition of control refers to users' abilities to customise and choose Web site contents to achieve their goals. We focus more on consumers' ability to control and easily interact with the 3D virtual model. Therefore, we define control as *users' abilities to customise and choose the contents of the virtual model (i.e., 3D product visualisation), rotate, and zoom in or out on the product in the virtual model and the ability of the virtual model (3D) to respond to participants' orders properly*. We hypothesise that:

H_{1a}: A high level of control of 3D product visualization increases authenticity.

Furthermore, 3D vividness should facilitate virtual experience by providing more sensory depth and breadth (Li et al., 2002, 2003). High-quality online animations enhance perceived telepresence (e.g., Fortin and Dholakia, 2005; Klein, 2003; Shih, 1998), and we hypothesise:

H_{1b}: A high level of 3D animation increases perceived authenticity.

Specifically, we consider vividness of the visual imagery, such that consumers can see online products with different colours (skins) just as they would see them in person. Media richness may lead to telepresence, according to research on online shopping (Klein, 2003; Schlosser, 2003). Moreover, consumers' ability to change the animation (colours) of the 3D product might help them sense control over the product. Therefore:

H₂: A high level of 3D animation increases control.

The Effects of Authenticity and Telepresence on Willingness to Purchase

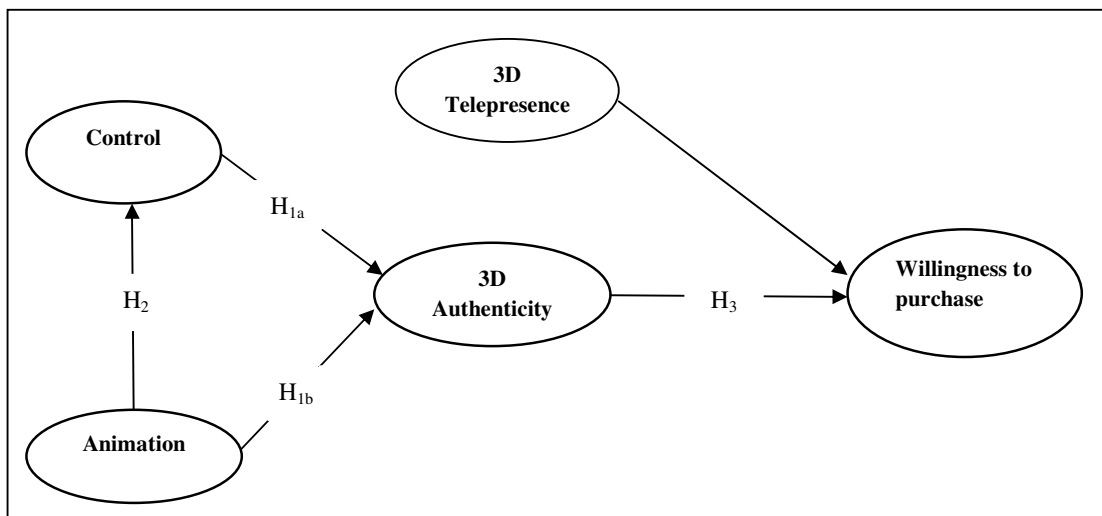
The role of 3D product visualisation in enhancing behavioural intentions appears well supported; it improves willingness to purchase from an online retailer (Fiore et al., 2005a,

2005b), intention to buy (Schlosser, 2003), purchase intentions (Li et al., 2001; Li et al., 2003) and patronage intention toward an online store (Kim et al., 2007). These studies generally report indirect effects of 3D product visualisation on consumers' responses (e.g., Fiore et al., 2005a; Lee et al., 2006). On the basis of our definitions of telepresence and authenticity, and to determine the impact of authenticity and telepresence on users' willingness to purchase we hypothesise:

H₃: The relationship between 3D authenticity and willingness to purchase from the online retailer is positive.

H₄: On the online retailer's Web site, 3D authenticity has a greater effect on users' willingness to purchase than does 3D telepresence.

Figure 1. Conceptual framework:



Source: Authors

METHODS

Stimuli, Procedures and Design

Stage 1

The goal of Stage 1 was to test the effects of the progressive levels of control and animated colours on 3D authenticity, in order to test H_{1A} and H_{1B} . We designed a hypothetical retailer's Web site with one stimulus for this study. The stimulus was illustrated on 3D product visualisation sites that allowed participants to view the focal product, laptops, from different angles; they also can rotate the products and zoom in or out on them. The 3D stimulus should help consumers imagine the product in appropriate and relevant ways and thus enhance their virtual experiences (Li et al., 2001). The website we created for this study was not previously known to users, nor did users have any knowledge of the fictitious brands on the site. Thus, we eliminated any impact of previous experiences or attitudes (Fiore et al., 2005a). The site offers a wide variety of laptops, similar to those that many college-aged women and men currently buy and use. Therefore, the site provides a suitable context for the present sample. We designed four 3D flashes (sites) for the 3D product visualisations, a 2 (control: high vs. low) \times 2 (animated colours: high vs. low) within-subjects design. The first flash contained a laptop that participants could zoom in or out on, rotate, change the colour and get information about its features and attributes. The second flash features a laptop that participants can zoom in or out on, rotate and change the colour, but only limited information about its external appearance is available (i.e., participants can only close and open the laptop). In the third flash, they can still zoom and rotate, but they cannot change the laptop colour. Finally, participants can do nothing with the laptop in the fourth flash; it just keeps rotating in front of them (see appendix A).

Participants and Time

Student samples are well suited to online shopping research (e.g., Balabanis and Reynolds, 2001; Fiore et al., 2005a; Kim et al., 2007; Li et al., 2002, 2003), because they are computer literate and have few problems using new technology. Students also are likely consumers of electrical goods (Jahng et al., 2000). We employed a sample of 24 post-graduate students to perform the influence of the progressive levels of control and animated colours on the authenticity construct. To eliminate individual differences, we employed a within-subjects design for all the experimental conditions. Each participant therefore represents his or her own control (Greene and d'Oliveira, 1999) and the design helps to reduce error variance associated with individual differences. The design also helps to improve the practicality of collecting data because we take several observations from the same subject (Greenwald, 1976;

Keppel and Wickens, 2004). Time exposure to a stimulus influences users' end responses (Zajonc, 2001), so several studies attempt to determine the appropriate time exposure to an online stimulus (e.g., Fiore and Jin, 2003; Fiore et al., 2005a; Kim et al., 2007). We followed these studies and set a time limit on the exposure in each experiment of five minutes. After viewing the stimuli for this time, the subjects completed a questionnaire.

3D Authenticity Variable

As no study, to the best of the authors' knowledge, has so far produced a valid, reliable scale to measure the 3D authenticity, we decided to fill the gap in this area. We followed Churchill's (1979) procedures to develop a suitable scale. Churchill (1979) advises marketers, after a comprehensive review of the literature, to specify the domain of a construct. From the 3D literature, we note that the authenticity construct derived from virtual experience contexts has not been empirically examined in the context of e-retailers. Whereas the notion of telepresence relates to a state of illusion or transportation (Lombard and Ditton, 1997), we notice that telepresence is not the proper terminology that marketers should use since it represents a process of being mentally transported into other areas or being immersed into an illusion environment. Instead, we explore the use of the authenticity construct to simulate a real authentic product that a consumer can experience when engaging with an online retailer. After reviewing the literature, we employed five focus groups with experts in e-retailing to identify the main themes, concepts and items to tap the underlying construct. The focus groups took place in July, 2008. Each focus group consisted of seven participants and lasted on average one hour. An initial pool of 10 items was collected, based on the previous literature and focus groups (see appendix B). To evaluate the initial items in the selected pool, we purified the measures by following two types of assessments. First, qualitative assessment, we submitted the items to evaluations by academics (lecturers in online retailing and Ph.D. students); these respondents considered the items relevant for measuring the authenticity construct. Second, quantitative assessment, using a student sample of 312 respondents, we ran item-to-total correlation coefficient taking only items correlated above 0.30. Five items that failed to achieve the correlation standard of 0.30 were discarded. Cronbach's alpha of the remaining five items was 0.872 which is above the recommended minimum threshold (.7). The five retained items each commenced with "After surfing the 3D sites ...", and then proceeded to the following: "3D creates a product experience similar to the one I would have when shopping in a store", "3D let me feel like if I am holding a real laptop and rotating it

(i.e. virtual affordance)”, “3D let me feel like I am dealing with a salesperson who is responding to my orders”, “3D let me see the laptop as if it was a real one”, and “Being able to zoom in/out and rotate the laptop let me visualise how the laptop might look in an offline retailer”. We ran an exploratory factor analysis on these remaining five items. The KMO statistic was 0.828, which is above the minimum recommended value of 0.60 (Kaiser, 1974) and the Barlett’s test of sphericity produced a χ^2 value of 792 ($p < 0.001$) suggesting an acceptable level of the common variance. We therefore use these five items as indicators of authenticity, representing the dependent variable in Stage 1.

Pre-test

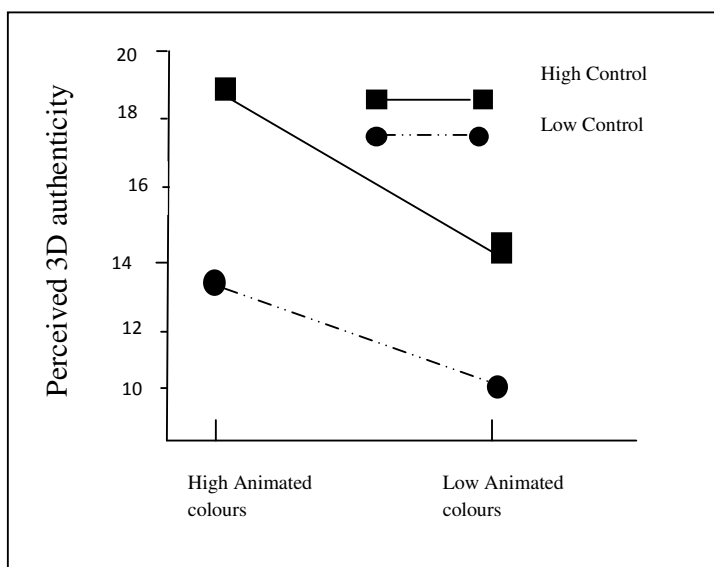
We ran a series of pre-tests to develop the study materials. In the first pre-test ($n = 30$), respondents were asked to rate several 3D flashes based on their controllability and colourability dimensions (5-point scales). Manipulation checks were used to decide if the participants noticed the differences between the various conditions of each construct. For controllability, participants explored a 3D flash that they could control by zooming in and out and rotating; and they also explored a 3D flash that zoomed in and out and rotated on its own, which they could not control. After each level they were shown the following question “To what extent do you consider that the 3D flash is controllable?” For colourfulness, participants explored a 3D site on which they could see different colours of the same laptop and they also explored a 3D site on which they could see the laptop only in a single colour. After each level they were shown the following question “to what extent do you consider that the 3D site is colourful?”. The results confirmed that participants noticed the different levels of each construct. They perceived the 3D Web site that they could zoom in or out and rotate as being significantly more controllable than the 3D Web site where they had no control of the zoom and rotation ($M_{\text{high control}} = 15.9$, $M_{\text{low control}} = 9.5$; $F_{1, 29} = 116.4$, $p < .001$). Moreover, they perceived the Web site with more colours as significantly more colourful than the Web site with one colour ($M_{\text{high colours}} = 11$, $M_{\text{low colours}} = 6.4$; $F_{1, 29} = 45.43$, $p < .001$) (see appendix A).

Findings and Discussion

We ran a two-way repeated measures ANOVA to compare the scores for the two levels of control and two levels of animation, with 3D authenticity as the dependent variable. The main effect of the control levels on authenticity is significant. We find a Wilks’ Lambda value of:

.275, $F(1, 23) = 60.778$ ($p < .001$), and an eta squared value of .725 (a large effect size according to Cohen, 1988). The means (M) and standard-errors (SE) of the control levels are as follows: $M_{\text{high}} = 17$, $SE_{\text{high}} = .551$ vs. $M_{\text{low}} = 11.7$ and $SE_{\text{low}} = .68$. The main effect of animation on authenticity also is significant, with a Wilks' Lambda of: .40, $F(1, 23) = 34.6$ ($p < .001$), and an eta squared value of .60. The means and standard errors are $M_{\text{high}} = 16.42$, $SE_{\text{high}} = .54$ vs. $M_{\text{low}} = 12.3$, and $SE_{\text{low}} = .704$). The results also indicate an insignificant interaction effect (control \times animation; $F(1, 23) = 2.272$, $p > .05$, $\eta^2 = .090$, see figure 2). Participants exposed to the condition with high control and high animation agreed that the site attained high authenticity ($M = 16.6$, $SD = 3.55$), but the site with low levels of control and animation achieved a low level of authenticity ($M = 10.1$, $SD = 3.47$). The high level of control and low level of animation ($M = 14.4167$, $SD = 4.49$), and low level of control and high level of animation ($M = 13.25$, $SD = 3.54$) also prompted ratings of a low level of authenticity. Overall, these results indicate that authenticity increases when control and animation levels increase. The participants noticed the manipulated conditions, and the results support H_{1a} and H_{1b} . Our results provide a strong evidence of the influence of the high levels of control and colour on 3D authenticity. Participants' ability to zoom in or out, rotate and change the laptop colours enhances their feelings of seeing and interacting with a real authentic object. Control and colours are tools that enhance consumers' virtual experience and 3D authenticity enables consumers to experience online products without directly inspecting them.

FIGURE 2. The Interaction Effects



Stage 2

Having found from Stage 1 that only high levels of the independent variables have high and significant effects on authenticity, we proceeded with Stage 2 using only the high levels of control and animated colours. Stage 2 aimed to test the effects of high levels of control and animated colours on authenticity and the effects of authenticity and telepresence on willingness to purchase.

Design and Participants

We designed a retailer website with one stimulus for this stage. The stimulus allowed participants to view a laptop's attributes, functions and characteristics; they also can zoom in or out, rotate it and see it with different colours. Moreover, unlike previous studies that focused on perceived product knowledge, our design enhances consumers' actual product knowledge (see Appendix C). The website that we created for this study was not previously known to users, nor did users have any knowledge of the fictitious brands on the site. Thus, we eliminated any impact of previous experiences or attitudes (Fiore *et al.*, 2005a). The site offers a wide variety of laptops, similar to those that many college-aged women and men currently buy and use. We used a sample of 312 students to perform this experiment. The sample was gender balanced, consisting of 48% women and 52% men, and 90% of the sample ranged from 18 to 30 years of age. Approximately 90% reported having had prior online shopping experience.

Instrument

Participants were informed that this study pertained to consumers' evaluations of an electrical retailer's Web site. The questionnaire contained five-point Likert-type scales, anchored by "strongly disagree" and "strongly agree".

To measure the control construct, we developed a five-item scale that centres on users' ability to rotate and zoom in the virtual model. Specifically, the items asked "After surfing the 3D sites...", "I felt it was very easy to zoom in/out the laptops", "I felt that I could choose freely what I wanted to see", "I felt that I had a lot of control over the content of the laptop's options", "I felt it was easy to rotate the laptop the way I wanted", and "I felt I could control the laptop movements".

To measure animation, we developed a four-item animation scale based on Klein's (2003) and Steuer's (1992) studies. The items tap how closely the simulated sensory information

reflects the real product, so respondents indicated “After surfing the 3D site, I think...”, “it provided me with accurate visual information about the laptops”, “Multicolour in the 3D laptop let me easily visualize what the actual laptop is like”, “Colours brightness of the 3D laptop let me visualize how the real laptop might look”, and “There are lots of colours on the 3D laptop websites”. For telepresence, we used a modified version of Kim and Biocca’s (1997) scale with four items: “I forgot about my immediate surrounding when I was navigating through 3D sites”, “While I was on the 3D sites, I sometimes forgot that I was in the middle of an experiment”, “While I was on the 3D sites, my body was in the room, but my mind was inside the world created by Brunel site”, and “While I was on this site, the world generated by Brunel (3D) was more real or present for me compared to the real world”. To measure authenticity, we used our scale as outlined in the ‘dependent variable’ section above. To measure willingness to purchase, we used a modified version of Fiore and colleagues (2005a) scale. Specifically, we asked “Assuming the laptops on the websites suit your taste or needs, how willing would you be to purchase a laptop from this online store?”, “After seeing the web site, how likely is it that you would buy a laptop from this online store?”, and “I would be willing to purchase a laptop through this online store”.

RESULTS

Model testing

We present the descriptive statistics and correlations between constructs in Table 1.

Table 1. Descriptive statistics and correlation coefficients.

Model Constructs	Mean	Standard Deviation.	Correlations				
			1	2	3	4	5
1. Animation	11.7	2.05	-----				
2. Control	12.1	2.23	.494	-----			
3. Authenticity	14.3	3.61	.639	.450	-----		
4. Telepresence	12.0	3.57	.251	.191	.479	-----	
5. Willingness to purchase	12.2	2.36	.332	.234	.455	.157	-----

All correlation is significant at the 0.01 level (2-tailed).

Measurement Model

We evaluated the measurement and structural equation models using SPSS AMOS. The measurement model includes 17 indicators, and we provide its results in Table 2 including the standardised factor loading, standard error, t-values, and average variance extracted. The standardised factor loadings (λ) are all greater than .6. The composite reliabilities for animation (.74), control (.86), authenticity (.88), telepresence (.86), and willingness to purchase (.74) are all within the ‘acceptable’ range (Hair et al., 1998).

Table 2. Measurement model results for hypothetical model with new factor structures.

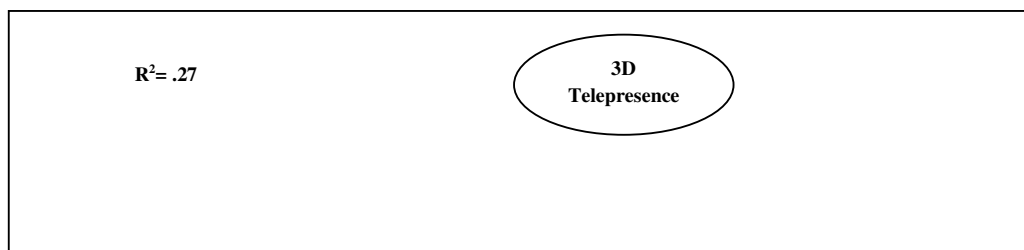
Construct Indicator	Standardized factor loading(λ)	S.E	t-value	Average variance extracted	Squared multiple correlation	Composite reliability
η_1 (Control)				0.68		0.86
- I felt I could control the laptop movements	.967	-			0.936	
- I felt it was easy to rotate the laptop the way I wanted.	.638	0.089	7.479		0.407	
- I felt that I had a lot of control over the content of the laptop’s options (i.e. angles and information)	.830	0.067	10.800		0.690	
η_2 (Animation)				.49		0.74
- Multicolour in the 3D laptop let me easily visualize what the actual laptop is like	.731	-			0.535	
- It provided me with accurate visual information about the laptops.	.663	0.083	10.216		0.44	
- Colours brightness of the 3D laptop let me visualize how the real laptop might look.	.698	0.104	9.951		0.487	
η_3 (Authenticity)				.64		0.88

- 3D let me see the laptop as if it was a real one.	.773	-			0.598	
- 3D Let me feel like I am dealing with a salesman who is responding to my orders	.797	0.080	13.816		0.635	
- 3D Let me feel like if I am holding a real laptop and rotating it (i.e. virtual affordance)	.827	0.082	14.342		0.684	
- - 3D Creates a product experience similar to the one I would have when shopping in a store.	.801	0.084	13.136		0.641	
η_4 (Telepresence)				0.62		.86
- I forgot about my immediate surrounding when I was navigating through 3D sites.	.638	-			0.407	
- While I was on the 3D sites, I sometimes forgot that I was in the middle of an experiment.	.848	0.130	10.347		0.719	
- While I was on the 3D sites, my body was in the room, but my mind was inside the world created by Brunel site.	.787	0.102	11.836		0.620	
- While I was on this site, the world generated by Brunel (3D) was more real or present for me compared to the "real world."	.852	0.134	10.342		0.725	
η_6 (Willingness to purchase)				0.70		.74
- Assuming the laptops on the websites suit your taste or needs, how willing would you be to purchase a laptop from this online store	.664	-			0.664	
- After seeing the web site, how likely is it that you would buy a laptop from this online store.	.785	0.065	15.946		0.785	
- I would be willing to purchase a laptop through this online store.	.639	0.062	14.809		0.639	

Structural equation model

The hypothesised model achieves a chi-square of 297.397 (df = 110), with a goodness-of-fit index (GFI) of .908, comparative fit index (CFI) of .928, root mean square residual (RMR) of .039 and root mean square error of approximation (RMSEA) of .074. These results indicate a good fit of the data to the model (Byrne, 2001; Hair et al., 1998). Furthermore, the structural equation model confirms that control and animation have significant positive effects on authenticity (H_{1a} $t = 2.308$; H_{1b} $t = 6.907$). Moreover, animation exhibits a significant positive effect on control (H_2 $t = 7.525$). Finally, as we hypothesised, authenticity has a significant positive effect on willingness to purchase (H_3 $t = 7.799$). However, 3D Telepresence does not have a significance effect on willingness to purchase ($t = -1.589$) (see Figure 3 and Table 3).

Figure 3. Structural path coefficients and R^2 for the effects of control and animation on authenticity and effect of authenticity and telepresence on willingness to purchase.



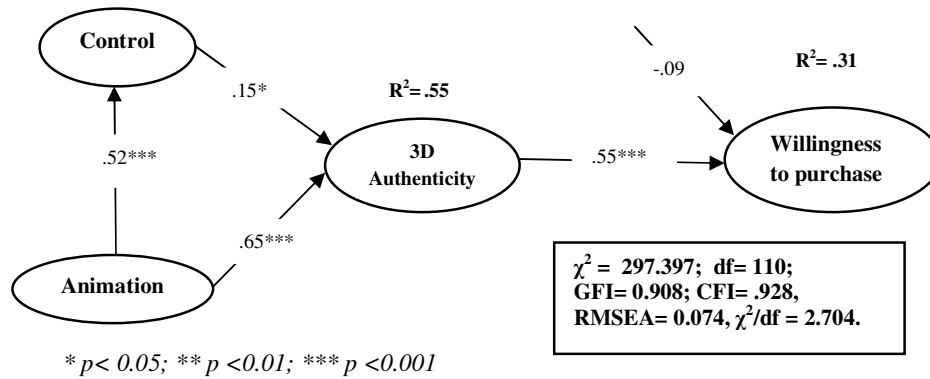


Table 3. Summary of results of structural model estimation.

Linkage in the model	Standardised Parameter (standard error)	t-value	Test result
Control → Authenticity	.15 (2.308)	2.308	H _{1a} Supported
Animation → Authenticity	.65 (.122)	6.907	H _{1b} Supported
Animation → Control	.52 (.105)	7.525	H ₂ Supported
Authenticity → Willingness to purchase	.55 (.069)	7.799	H ₃ Supported

To demonstrate the significantly greater influence of 3D authenticity compared with 3D telepresence and on willingness to purchase (H₄), we alternately constrain and release these paths. Table 4 compares the chi-square and CFI differences between the above two constructs, demonstrating that 3D authenticity has significantly more impact than 3D telepresence on willingness to purchase, supporting H₄.

Table 4. Comparison between the effects of 3D authenticity and 3D telepresence constructs on willingness to purchase when constraining and releasing them.

χ^2 when constraining Authenticity and releasing Telepresence	CFI when constraining Authenticity and releasing Telepresence	χ^2 when constraining Telepresence and releasing Authenticity	CFI when constraining Telepresence and releasing Authenticity	$\Delta \chi^2$	Δ CFI	<i>P</i>
369.907	0.901	299.958	0.928	69.949	.027	Sig.

DISCUSSION, CONTRIBUTION and IMPLICATIONS:

This research adds to the literature the notion of 3D authenticity and presents a valid scale to measure it. As such, it is the first study to empirically explore the antecedents of 3D authenticity. Previous scholarly literature that used and applied the notion of telepresence to reflect consumers' experience in simulating the bricks-and-clicks retailers' is concerned with the extent to which consumers feel that they are dealing with products that do not exist. On the other hand, our authenticity construct refers to the ability to imagine a virtual object as real. Our authenticity scale is suitable and convenient for academics and practitioners interested in using 3D to simulate real products in the online retail context. Our results support the previous theoretical work of Lee (2004) which revised previous definitions of telepresence and presence and argued that none of the previous definitions could be used to tap the concept of using virtual environments to reflect the consumer experience. Lee proposed using "Para-authentic objects" to simulate virtual versions of real life objects. Our results provide empirical support for that proposition. Furthermore, our 3D authenticity construct reflects Klein's (2003) notion of realism in telepresence, which Klein advised marketers to apply in order to positively influence product beliefs. Our results demonstrate that 3D authenticity is more relevant than 3D telepresence for marketers concerned with using 3D to enhance willingness to purchase within the online retailer context.

Theoretical Implication

In line with other online retail researchers who investigated the influence of using 3D, we find that marketers should focus on specific aspects of interactivity and vividness when designing their 3D sites. For example, the empirical support for control as representative of interactivity solved a long debate among previous researchers. When it comes to virtual models, we prefer focusing on the narrowest, most relevant aspects of interactivity (i.e., control). Furthermore,

the vividness construct should be narrowed down to visual stimulus. Researchers might benefit from a tighter focus on specific aspects of vividness through illustration, as we have in this research.

The antecedents of authenticity (i.e., control and colour) seem similar to those of telepresence (e.g., Coyle and Thorson, 2001; Klein, 2003). However, when investigating the antecedents of authenticity, researchers should focus on certain real elements of interactivity and vividness rather than on the abstract constructs. Whereas Heeter (2000, p. 75) describes interactivity as “*an overused and under defined concept*”, we posit that control represents a useful construct for 3D models in the online retail context, in support of previous research (Ariely, 2000; Coyle and Thorson, 2001). We narrow our conceptualisation of control to consumers’ ability to control the content and form of the 3D flashes. In other words, users’ ability to zoom in or out, rotate and get more information about the product enhances their perceptions of the authenticity of the products. Furthermore, whereas prior research defines vividness according to sensory breadth and depth, we argue that research might benefit from a tighter focus on specific aspects of vividness through illustration, such as we have applied here. This result is in accordance with Pimentel and Teixeira’s (1994, p. 146) study that asserts that visual stimuli are the main sensory cues in producing virtual experiences. Our results reveal a positive relationship between 3D authenticity and willingness to purchase, compared with a non-significant one between telepresence and willingness to purchase, indicating that authenticity has more (positive) influence on willingness to purchase in comparison to telepresence.

Managerial Implications

E-retailers should pay more attention to 3D authenticity antecedents, i.e., control and colour when designing their 3D virtual models. Including real colours and flashes that consumers can control easily will lead to more authentic online experiences. Any 3D flash should include the essential information that consumers seek rather than just a pretty picture. For example, consumers should be able to click on any part of the 3D flash to get access to information about it.

Web site developers should take advantage of technological advancements to develop and update online retailers’ 3D flashes. Pechtl (2003) asserts a positive relationship between perceived innovation attributes and online adoption behaviour. Managers and Web sites designers should work together to ensure that the 3D product visualisation provides customers with the complete and accurate information they need. In addition, marketers should decide

what information (or knowledge) to focus on before developing 3D flashes. It should be accepted that developing 3D flashes is not a money-free issue. Nevertheless, many companies have already claimed to have improved their sales as a result of designing and using 3D flashes. For example, J.C. Penny, eBags and Wal-Mart claimed that their online sales have increased 10% to 50% after using rich media such as 3D flashes (Demery, 2003). Moreover, Demery (2006) posits that the numbers of companies who are investing in 3D virtual models is increasing steadily because these companies are seeing the potential of the technology for selling more products. Nantel (2004) asserts that consumers shopping online for clothing are 26% more likely to purchase from the sites that have 3D virtual model than from sites that have not. Moreover, Fiore (2008) posits that media richness is an important way to differentiate retailers. Wagner (2000) asserts that online retailers with 3D product visualisations may reap benefits that extend beyond sales. For example, 3D increases site stickiness: users will spend more time on the online retailer, which leads to more opportunities to learn more about the products, interact with them, build trust and confidence. Finally, according to the Social Issues Research Centre (SIRC, as cited in Herrod, 2007) study it is expected that “by 2020 virtual commerce (v-commerce) will replace e-commerce” and the development of 3D virtual models (such as 3D virtual shopping malls) will be leading the whole industry by 2020.

LIMITATIONS AND FURTHER STUDIES

Although the generalisability of the results is limited by the student sample, and cannot be generalised to all online consumer groups, we argue that students represent the shoppers of tomorrow (Balabanis and Reynolds, 2001) and the research thus has prescient value. Second, since this study has focused only on laptops, which we considered to be products that are associated with more search or experience, it is unclear to what extent the results can be generalised and applied to other online products.

On the bases of our results, we recommend that Web site developers should pay more attention to simulating 3D animation colours to reflect the real products more authentically. Moreover, they should work to create an environment in which consumers sense that they can feel the online products when they navigate the site. Further research should consider whether adding hedonic and utilitarian constructs to our model influence behavioural intentions. We recommend research efforts to extend the generalisability of our findings to other contexts (e.g., clothing) and to non-student samples. Further research may add and test other stimuli,

for example by simulating real sounds to investigate how auditory vividness may influence 3D authenticity.

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Appendix A:

Progressive levels of 3D Authenticity Antecedents; Control and Animated Colours constructs (Stage 1).



Appendix B: An initial item pool:

1. [X] I felt that I can touch it by hand.
2. [X] I felt that I' am holding a laptop and moving it.
3. [X] I felt that I' am dealing with a salesman.
4. [X] I felt that being able to zoom in or out, rotate the laptop and change its colours, let me visualise how a laptop look like in an offline retailer..
5. [X] like the experience you would have when shopping in a store.
6. [X] In the laptop what you see is what you get
7. [X] defiantly, it gives me more information about how the product how it looks from inside, the colours
8. [X] 3D authenticity let me see the laptop as if it was a real one.
9. [X] this is much visible for the colour; you can see the colour you can see what ever.
10. [X] what you see in the 3D laptop is what you got on the high street.

Appendix C

Stage 2

